AQUATIC NUISANCE CONTROL IN ONTARIO

1975-1979

Ministry
of the
Environment

Ontario

The Honourable
Harry C. Parrott, D.D.S.,
Minister

Graham W. S. Scott, Q.C.,
Deputy Minister

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INTRODUCTION

Under The Pesticides Act, 1973 and Regulations, a person applying a pesticide directly to water must obtain a water extermination licence and an aquatic nuisance control permit. However, there are exemptions under the Regulations: for example, no licence is required where an individual treats water on his own premises, or his own cottage frontage, in a lake other than a crown lake. On the other hand, however, a cottage association treating on behalf of a number of cottagers does require an exterminators licence and a permit. No permit is required if the treated water does not drain or move into a public water course, or water body other than by percolation (i.e., if pesticide application is to be made to a land-locked run-off pond which has no outflow, or farm drainage ditch which contains no water at the time of treatment).

The licence requirement ensures that pesticide applications to areas of significant size and accessible to the public are made safely and with proper consideration of sound management practices. Permits authorize the use of a registered pesticide under specific conditions, and are issued on an annual basis by the Ministry of the Environment in co-operation with the Ministry of Natural Resources. While responsibility for ensuring the use of a suitable herbicide, and assessing the possible hazards to other water users, rests with the Ministry of the Environment, personnel of the Ministry of Natural Resources are responsible for establishing possible detrimental effects on local fish and wildlife populations through habitat alteration or destruction.

The pesticide which may provide the greatest degree of control depends both on the species of nuisance plants and on other factors, such as plant density, height and age of plant. Aquatic plants may be annuals or perennials. Since, in the year following a herbicide treatment, the plant community composition may change and the plants may be more resistant or more susceptible to a herbicide, it is important to keep a close watch and modify control methods where necessary. Thus, the permit issued is only good for the year in which it is issued; renewals have been required on an annual basis since 1971. Prior to that, a permit was valid for up to two years following issuance. This must be remembered where permit statistics are compared.

To assist in reinforcing the education and experience of the applicant, and to assess the quality of information and advice provided to the public, questionnaires have been circulated every fall since 1972 to permittees; where it is indicated that the permittee intends to repeat the treatment the following year, blank permit application forms are immediately sent out. During the remainder of the year enquiries come from letters and phone calls to the Ministry of the Environment in Toronto, or field or district offices of the Ministry of Natural Resources; over 3,000 "information kits" are sent out per year.

Thus far, the administration of the system has rested with the Pesticide Control Section in Toronto, with the permit signing authority resting with the Director under the Pesticides Act. Final copies of all permits are sent to the appropriate field offices of the Ministry of Environment and Ministry of Natural Resources to keep local staff advised of local programs and policies.

Information on alternative methods of aquatic plant control is also distributed. For example mechanical harvesting of plants has occurred in some recreational lakes south of the Precambrian Shield irregularly since the late 1960's. Ministry of Environment staff of the Water Quality Section, Water Resources Branch, Rexdale, undertook a comprehensive study of harvesting 1974-77; in 1976-78 approximately 1,000 acres per year of nuisance plants were cut. In 1979, private harvesters undertook a number of private contracts; information on how much was removed from where is not available as no permit system at present monitors this means of control.

All research work conducted using unregistered aquatic herbicides must be authorized by an aquatic nuisance permit, as specified by the Pesticides Act 1973. This information is published in the Research Report of the Expert Committee on Weeds (formerly the Canada Weed Committee) Agriculture Canada, Eastern Section. Field tests are authorized only after laboratory toxicological studies and efficacy trials have been completed. Tests in enclosed dugouts precede any open water trials.

Much of the following data is numerical. This data must be understood to be general information only as complete details on actual as opposed to authorized use are not available for 100% of the clientele. Reports on use have not been mandatory, but questionnaire returns are adequate to indicate trends.

In summary, the use of aquatic herbicides has not increased to any significant extent during the past five years. Herbicides are not available to solve all problems. Results are cosmetic in nature, and beneficial only in the short term. The financial aspects have been carried entirely by the individual or local association. There has been a relatively small increase in the amount of aquatic herbicide used in Ontario even though growth of Eurasian water milfoil expanded dramatically. When and where aquatic plants have ceased to be an excessive nuisance, herbicide use has declined.

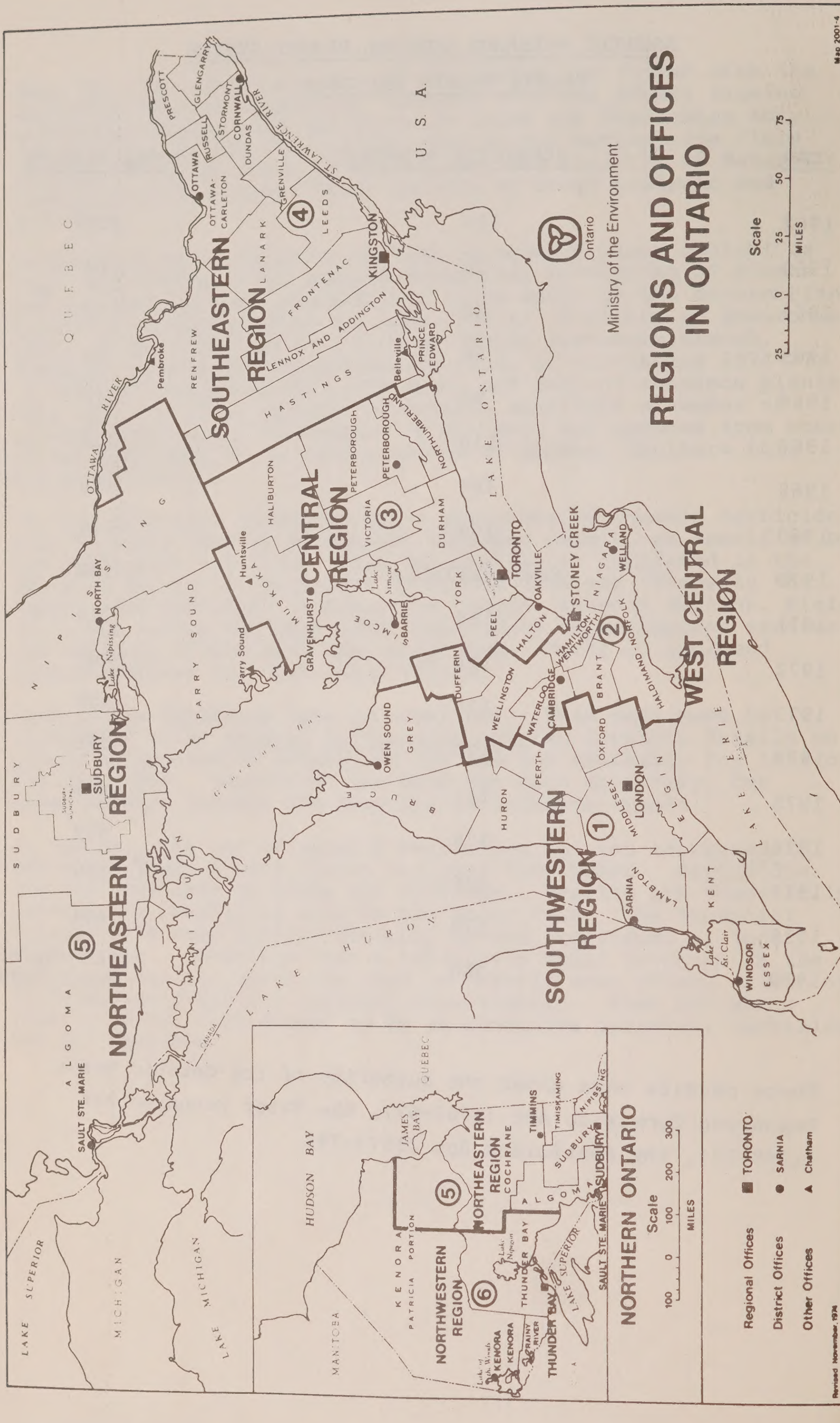
TABLE 1

AQUATIC NUISANCE CONTROL PERMIT SYSTEM

Permit Totals Per Year

YEAR	HERBICIDE PERMITS	TOTAL PERMITS
1962	125	140
1963	36	64
1964	37	53
1965	30	41
1966	90	110
1967	116	137
1968	162	185
1969	194	219
1970	Not available	182
1971	184	212
1972	194	207
1973	126	150
1974	150	171
1975	211	241
1976	378	450
1977	406	459
1978	370	404
1979	368	432(as of Nov. 7/79)

These permits were under the authority of the Ontario Water Resources Commision Act (1962-67), the Water Resource Act (1968-72), the Pesticides Act (1973-79).


REGIONS AND OFFICES IN ONTARIO
Ministry of the Environment
Ontario
Scale
MILES
Regional Offices
District Offices
Other Offices
TORONTO
SARNIA
Chatham
NORTHEASTERN REGION
SOUTHEASTERN REGION
CENTRAL REGION
WEST CENTRAL REGION
SOUTHWESTERN REGION
NORTHWESTERN REGION
NORTHERN ONTARIO
QUEBEC
U. S. A.
MICHIGAN
LAKE SUPERIOR
LAKE HURON
LAKE ONTARIO
LAKE ERIE
LAKE MICHIGAN
HUDSON BAY
JAMES BAY
MANITOBA
ST. LAWRENCE RIVER
OTTAWA RIVER
ALGOMA
SUDBURY
NIPISSING
PARRY SOUND
MANITOULIN
MUSKOKA
HALIBURTON
RENFREW
HASTINGS
LENNOX AND ADDINGTON
FRONTENAC
LANARK
LEEDS
GRENVILLE
OTTAWA-CARLETON
RUSSELL
PRESCOTT
GLENGARRY
STORMONT
DUNDAS
PRINCE EDWARD
NORTHUMBERLAND
PETERBOROUGH
VICTORIA
DURHAM
YORK
PEEL
HALTON
SIMCOE
DUFFERIN
GREY
BRUCE
WELLINGTON
WATERLOO
HAMILTON-WENTWORTH
NIAGARA
BRANT
HALDIMAND-NORFOLK
OXFORD
PERTH
HURON
MIDDLESEX
ELGIN
LAMBTON
KENT
ESSEX
KENORA
PATRICIA PORTION
THUNDER BAY
RAINY RIVER
COCHRANE
TIMISKAMING
SAULT STE. MARIE
NORTH BAY
Pembroke
OTTAWA
CORNWALL
KINGSTON
Belleville
PETERBOROUGH
Huntsville
GRAVENHURST
BARRIE
Parry Sound
OWEN SOUND
TORONTO
OAKVILLE
STONEY CREEK
WELLAND
CAMBRIDGE
LONDON
SARNIA
WINDSOR
TIMMINS
Lake Nipissing
Lake Simcoe
Lake St. Clair
Lake Nipigon
Lake of the Woods
Georgian Bay
Revised November, 1974
Map 2001-4

REGIONAL AND DISTRICT OFFICES

DON MILLS	150 Ferrand Drive, Suite 700, DON MILLS, Ontario M3C 1H6	Tel: (416) 424-3000 ext. 204
BARRIE	P.O. Box 937, 12 Fairview Road, BARRIE, Ontario L4M 4Y6	Tel: (705) 726-1730
PETERBOROUGH	139 George Street, PETERBOROUGH, Ontario K9J 3G7	Tel: (705) 745-4601
STONEY CREEK	Centennial Plaza, 140 Centennial Parkway North, STONEY CREEK, Ontario L8E 1H9	Tel: (416) 561-7412
CAMBRIDGE	P.O. Box 219, Clyde Road, CAMBRIDGE (GALT), Ontario N1R 5W6	Tel: (519) 623-2080
SIMCOE	P.O. Box 473, 1 Robinson Street, Suite #9, Woolworth Building, SIMCOE, Ontario N3V 4L5	Tel: (519) 426-1940
NORTH BAY	Northgate Shopping Centre 1500 Fisher Street, NORTH BAY, Ontario P1B 2H3	Tel: (705) 476-1001
TIMMINS	P.O. Box 1330, 46 Main Street, TIMMINS, Ontario P4N 2V3	Tel: (705) 264-9474
THUNDER BAY	Ontario Government Building, 435 James Street South, P.O. Box 5000, THUNDER BAY (F), Ontario P7E 6E3	Tel: (807) 623-5591
BELLEVILLE	15 Victoria Avenue, BELLEVILLE, Ontario K8N 1Z6	Tel: (613) 962-9208
OTTAWA	2378 Holly Lane, Suite #204, OTTAWA, Ontario K1V 7P1	Tel: (613) 521-3450
LONDON	985 Adelaide Street South, LONDON, Ontario N6E 1V3	Tel: (519) 681-3600
CHATHAM	P.O. Box 237, 435 Grand Avenue West, CHATHAM, Ontario N7M 5K3	Tel: (519) 352-5107
CLINTON	P.O. Box 688, Ontario Ministry of Agriculture and Food Building CLINTON, Ontario N0M 1L0	Tel: (519) 482-3428

TABLE 2

AQUATIC NUISANCE CONTROL PERMITS

Permits Handled And Issued

YEAR	HERBICIDE APPLICATIONS RECEIVED	HERBICIDE PERMITS ISSUED	OTHER APPLICATIONS RECEIVED	OTHER PERMITS ISSUED	TOTAL APPLICATIONS RECEIVED	TOTAL PERMITS ISSUED
1975	211	194	30	25	241	219
1976	378	358	72	67	425	
1977	406	387	53	53	459	440
1978	370	366	34	34	404	400
1979	368	359	64	61	432	420

*Other permit applications were for use of:

(i) Black fly larvicide : temephos (Abate liquid)

(ii) Mosquito larvicides : temephos (Abate liquid and granular)
chlorpyrifos (Dursban liquid and granular)
pyrethrin (torsit capsules)
malathion (50 EC liquid)

(iii) Piscicides : rotenone (Warbicide 5, Noxfish, ProNoxfish).

Statistic on use of these pesticides were not compiled for this report.

TABLE 3

AQUATIC NUISANCE CONTROL PERMITS PER MOE REGION

YEAR	REGION 1	2	3	4	5	6
HERBICIDES						
1975	13(5 cancelled)	15(3 cancelled)	115(1refused) (2cancelled)	62(1refused) (5cancelled)	6	0
1976	18(1refused) (1cancelled)	27(3refused)	24(7refused) (1cancelled)	79(3refused) (1cancelled)	13	0
1977	10(1refused) (1cancelled)	23(1cancelled)	256(11refused)	106(2refused)	9(1refused) (1cancelled)	2(1refused)
1978	11	37	216(2refused) (1cancelled)	87(1cancelled)	16	3
1979	6	32	201(5refused) (1cancelled)	124(2refused) (1cancelled)	5	0
OTHER						
1975	2	4	7	4(1refused)	9(4cancelled)	4
1976	16(1refused)	16(2cancelled)	25(1refused)	6(1cancelled)	5	4
1977	9	18	17	1	3	5
1978	5	12	9	5	3(1cancelled)	1
1979	5	10	14	15(2cancelled)	14(1cancelled)	6

1975,76 Eurasian water milfoil increased dramatically in Trent-Severn and Rideau waterways.

1976,77 A number of municipalities in southwestern Ontario mounted mosquito larvicide programs.

1979 Ministry of Natural Resources increased the number of lake reclamation programs (using rotenone).

TABLE 4. HABITATS OF COMMON AQUATIC PLANTS

	SPRING-FED POND 1	ENCLOSED DUGOUT 2	SOFT WATER LAKE * 3	HARD WATER LAKE ** 4	WET DITCH *** 5	DRY DITCH **** 6
ALGAE						
Spirogyra sp.	VC	VC	C-I		VC	I
Ulothrix sp.	C	VC			VC	
Mougeotia sp.	C	VC			VC	
Cladophora sp.	VC	VC	C	VC	VC	
Chara sp. (Muskgrass)	VC	I	C-I	VC-I	VC	R
Nitella sp. (Stonewort)	I	R	C	R	R	R
SUBMERGENT MACROPHYTES						
Sago pondweed (P. pectinatus)	I	C-I		VC		
Curly-leaf pondweed (P. crispus)	C	VC		VC		
Bass weed (P. amplifolius)	R	C		C		
Richardson pondweed (P. richardsonii)				VC-C		
Flat stemmed pondweed (P. zosteriformis)				C		
Other narrow-leaf pondweeds (Potamogeton sp.)	I	C	C	VC-C		
Eurasian water milfoil (Myriophyllum spicatum)				VC		
Native milfoil (M. exalbescens and others)	C		C	VC		
Bladderwort (Utricularia vulgaris)		C		C		
Coontail (Ceratophyllum demersum)		C		VC		
Water Stargrass (Heterantheria dubia)				C		
Tape grass (Vallisneria americana)	R	I	C	VC	R	R
Water naiad (Najas flexilis)		I		VC		
Canada water weed (Elodea canadensis)		C		VC		
EMERGENTS						
Cattails (T. latifolia, T. angustifolia)	VC	VC		VC	VC	I-C
Bulrush (Scirpus spp.)			C	VC	C	C
Sedge (Carex sp.)			C	C	C	VC
#Bur reed (Sparganium spp.)	C		C	C	C	VC
Water plantain (Alisma spp.)			I	C	C	VC
Pipewort (Eriocaulon spp.)	R	R	C	R	R	R
Arrowhead (Sagittaria spp.)			C		VC	I-C
pickerelweed (Pontederia spp.)			VC		I	R
Water smart weed (Polygonum amphibium)	I	I				
Water shield (Brasenia spp.)			C			
White water lily (Nymphaea spp.)			C	C		
Yellow water lily (Nuphar spp.)		C-I	C	C		
Duckweed (Lemna spp.)	R	C	I-R	VC		
Duckmeal (Wolffia spp.)	R	C-I	I-R	VC		

VC - Very common
C - Common
I - Infrequent
R - Rare

\# - Bur reed is also very common as a submerged plant in ecotypes 3 and 4.
* - A typical Muskoka lake is an example of a soft water lake.
** - A typical Kawartha Lake is an example of a hard water lake.
*** - A wet ditch generally contains water 80 - 90% of the year.
**** - A dry ditch generally contains water 50% or less of the year.

TABLE 5. HERBICIDE SUSCEPTIBILITY OF COMMON AQUATIC PLANTS

		1	2	3	4	5	6	7
ALGAE								
Spirogyra sp.		S	S	S	R	R		
Ulothrix sp.		S	S	S	R	R		
Mougeotia sp.		S	S	S	R	R		
Cladophora sp.		I	S	S	R	R		
Chara sp. (Muskgrass)		I	S	S-I	R	R		
Nitella sp. (Stonewort)		I	S	S-I	R	R		
SUBMERGENT MACROPHYTES								
Sago pondweed (P. pectinatus)		R	R	S	S	S		
Curly-leaf pondweed (P. crispus)		R	R	S	S	S		
Bass weed (P. amplifolius)		R	R	S-I	I			
Richardson pondweed (P. richardsonii)		R	R	S-I	S-I	S		
Flat stemmed pondweed (P. zosteriformis)		R	R		S			
Other narrow-leaf pondweeds (Potamogeton sp.)		R	R	S	S	S		
Eurasian water milfoil (Myriophyllum spicatum)		R	R	S	VS	VS		
Native milfoil (M. exalbescens and others)		R	R	S	VS	VS		
Bladderwort (Utricularia vulgaris)		R	R	S	S-I			
Coontail (Ceratophyllum demersum)		R	R	S-I	I	I		
Water Stargrass (Heterantheria dubia)		R	R		S-I			
Tape grass (Vallisneria americana)	*MM	R	R	R	R	R	R	R
Water naiad (Najas flexilis)		R	R	S	S			
Canada water weed (Elodea canadensis)		R	R	S-I	I	S-I		
EMERGENTS								
Cattails (T. latifolia, T. angustifolia)	M	R	R	R	R	R	I	S-I
Bulrush (Scirpus spp.)	M	R	R					S-I
Sedge (Carex sp.)	M	R	R					S-I
Bur reed (Sparganium spp.)	M	R	R					I
Water plantain (Alisma spp.)		R	R					S
Pipewort (Eriocaulon spp.)	*M	R	R				S	
Arrowhead (Sagittaria spp.)		R	R				S	
Pickerelweed (Pontederia spp.)		R	R				S-I	
Water smart weed (Polygonum amphibium)		R	R				S-I	
Water shield (Brasenia spp.)		R	R				S-I	
White water lily (Nymphaea spp.)	*M	R	R			I	I	
Yellow water lily (Nuphar spp.)	*M	R	R			I	I	
Duckweed (Lemna spp.)		R	R		S		S	
Duckmeal (Wolffia spp.)		R	R		S		S	

1 - Copper sulphate
2 - Cutrine Plus; Algimycin PLL-C
3 - Simazine, diuron (in enclosed pond systems only)
4 - Diquat
5 - 2,4-D granular
6 - Paraquat
7- Amitrole, dalapon, glyphosate (in dry ditches only)

S - Susceptible
I - Intermediate
R - Resistant
M - Manual/mechanical methods equally as effective as herbicides.
*M - Manual/mechanical methods generally more effective than herbicides.
*MM - Manual/mechanical methods are the only control measure currently available.

AQUATIC HERBICIDES RECOMMENDED FOR USE IN ONTARIO 1975

WEEDS	TREATMENT
Filamentous algae, pond scums	Copper sulphate (Bluestone) 1.4 to 2.7 lb product per acre-ft* of water to be treated. (Equivalent to .5 to 1 part per million-ppm). A rate not exceeding .7 ppm to control filamentous algae should be used in ponds containing trout, with the treatment being repeated after a few days if necessary.
Filamentous algae, pond scums	Treatment of streams, fast flushing ponds and public waters such as lakes with copper sulfate is not a registered use.
	Cutrine, a liquid algicide, is a chelated copper complex which remains in solution in hard water, unlike copper sulphate. 100 fl oz per acre-ft (2.9 ppm product) in moderately hard water. Water flow in ponds should not be entirely shut off during or following treatment as the subsequent oxygen depletion in a closed system may be toxic to aquatic organisms. In soft water ponds, where trout are present, chemical dosage should be halved and minimal treatment undertaken only where necessary. This compound is not to be used in lake or open water treatments.
	Simazine (Simmaprim) wettable powder, 1.4 lb active per acre-ft (0.5 ppm). This algicide is not effective for partial treatment in lakes or large ponds or in ponds where there is significant flow-through at the time of treatment.
	Diuron (Karmex) wettable powder. In ponds with little or no water exchange apply 1.4 lb active per acre-ft (0.5 ppm).
Submerged plant-like alga: Chara and Nitella spp. in ponds	Copper sulphate (Bluestone) 4-5.5 lb product per acre-ft (1.5-2 ppm) where fish are not present. Allow coarse granules to sink for most effective control. Do not use in lakes or streams.
	Cutrine 200 fl oz product per acre-ft (5.8 ppm product) for control of moderately dense stands of Chara. Significant pond outflow should be reduced but not entirely shut off. To avoid oxygen depletion treat one half of the pond at one time and the remainder 4 days later. In soft water ponds, where trout are present or where water hardness is unknown, Cutrine should not be used.

* An acre-foot = volume of water that is 1 acre in area and 1 foot deep. To determine the number of acre-feet in a pond, calculate the surface area in square feet or acres and then:

	Simazine (Simmaprim) wettable powder. 5.4 lb active per acre-ft (2 ppm) in ponds where water flow is stopped for 10 days following treatment. Apply early in the season (mid-May to mid-June) to minimize oxygen depletion. Do not use where willows or other trees are growing along pond margin, as damage may result.
	Diuron (Karmex) wettable powder. 5.4 lb active per acre-ft (2 ppm) in ponds where water flow is stopped for 10 days following treatment. Apply early spring. Do not use where there are marginal willows or valuable ornamentals.
Chara spp. and mixed submergents in ponds	Drawdown treatments (draining pond or reservoir). Use simazine or diuron at rate of 20 lb (active) per acre. Mix the herbicide with water and spray directly on to exposed soil. After treatment, wait approximately two weeks before flooding. Treat either May or September.
Mixed submergents in ponds (excluding Chara)	Simazine (Simmaprim) wettable powder. Total volume treatment using 2.7-5.4 lb active per acre-ft (1-2 ppm) in ponds where water flow is restricted for 10 days immediately following treatment.
	Diuron (Karmex) wettable powder. Total treatment using 2.7-5.4 lb active per acre-ft (1-2 ppm) in ponds where water flow is restricted for 10 days immediately following treatment.
Mixed submerged aquatics in ponds and lakes	Diquat (Reglone A) 2 gal commercial product per surface acre of water. Apply at dusk, mid to late June when plants are young and growing vigorously. Tape grass and Chara are not controlled.
	2,4-D ester granular (Aqua Kleen) 20 to 30 lb (active) per surface acre. Use lower rate for stands of water milfoil only, and higher rate for mixed submergents. Tape grass and chara are not controlled.
Emergents: Arrowhead, Pickerel weed, Wild rice, cattails, bulrushes	Paraquat (Gramoxone) 1 to 2 lb (active) in 75 to 100 gal water per acre. ½ to 1 gal product per acre. Apply when seed heads are forming, usually late July or August, 2 to 4 fl oz (product) in 4 gal water per 1,000 sq ft. Treatment of plants in swamps, lake edges and ditches containing water is an acceptable use of this compound.
Cattails, bulrushes in low areas on farms and drainage ditches when water is not present	Amitrole (Amino Triazole) 8 to 10 lb (active) per acre, mixed in 400 gal water. 1/5 to 1/4 lb (active) in 10 gal water per 1,000 sq ft.

	Dalapon 10 to 20 lb (product) per acre, mixed in 100 gal water. 3/4 to 1/2 lb (product) in 4 gal water per 1,000 sq ft.
	Paraquat (Gramoxone) 1 to 2 lb (active) in 75 to 100 gal of water per acre. Apply when seed heads are forming, usually in late July or Qugust. 2 to 4 fl oz (product) in 4 gal water per 1,000 sq ft.
Water lilies	2,4-D ester (Aqua Kleen) 25 to 30 lb (active) per surface area.
Duckweed	Diquat (Reglone A) 1 gal commercial product per acre. Apply by directed surface spray on foliage, not underwater injection.

1. If calculating in square feet, multiply the surface area by the average depth, which will give the total volume in cubic feet. Then divide total by 43,560 (sq ft per acre) to give acre-feet.

2. If calculating in acres, simply multiply the number of acres by the average depth, to give acre-feet. When determining the average depth of a pond, it is necessary to take sufficient soundings and to consider the surface proportions related to varying water depths.

Aquatic plant control presents a number of unique problems. The use of herbicides may be complicated by the use of water by livestock, or humans or by the presence of fish. If the water is flowing, the effect of the chemical on plant, animal, or fish life downstream must be considered. Flowing water, by diluting the herbicide, makes control less effective. The vegetation also varies widely, from completely submerged ones such as Canada waterweed (Elodea) and algae, to free-floating ones such as duckweed, and anchored-floating ones, such as water lilies, to emergent plants. Many of these will grow equally as well on the moist shoreline as when their lower stems and roots are in water. Where these emergent species have taken possession of the shoreline, control measures must embrace that area as well as the water.

Copper sulphate is the standard treatment for algae control in ponds. At the concentration given, it is non-poisonous to most fish and livestock. The copper sulphate may be dissolved in water and applied to the pond surface as a spray, or it may be placed in a burlap bag and dragged through the water until it has dissolved. Long term or permanent control of algae in ponds is not possible because of its ability to rapidly re-infest an area.

Simazine or diuron can provide a season's control of algae in ponds having a minimum flow-through. Until further residue studies are completed, simazine and diuron should not be applied to ponds used for irrigation.

Chara (muskgrass) is a grey-green to green alga attached to the sediment which, in dense communities, has a very strong musk odor. It is brittle to the touch and dries to a white powder upon removal from the water. This plant, which is usually found in hard water trout ponds, is very difficult to control with moderate doses of algicides, and dense communities should be removed mechanically.

Another submergent, tape grass or wild celery Vallisneria americana commonly found in many recreational lakes, is resistant to all the currently recommended herbicides. It has long ribbon-like leaves and numerous short roots. Control of this species for the present must be confined to mechanical methods such as pulling.

Diquat has been shown to provide good control of wide variety of submergent species including water milfoil, pondweeds, Canada waterweed Elodea and coontail. This herbicide is not effective against stonewort or muskgrass Chara or tape grass or wild celery Vallisneria. It is not necessary to calculate water volumes when applying this herbicide as it will work effectively at depths up to eight feet when applied at a rate of 2 gal product per acre. One gallon per acre has provided excellent results where water-milfoil is the only species present. Diquat should be applied on cloudy days or in late afternoon and care should be taken not to stir up the bottom since turbidity reduces the effectiveness of treatment. Since Diquat takes effect rapidly, decomposition of a large plant mass may produce oxygen depletion problems which can cause fish to suffocate. Thus, in ponds where fish are present and growth is well established, half of the pond should be treated at one time and the other half about two weeks later. The best time to apply these chemicals is late spring while the plants are maturing rapidly but after the water temperature exceeds 65 F. Fish tolerance to these chemicals is high and aquatic insects and other invertebrates do not appear to be affected. Follow manufacturer's directions closely, noting waiting periods before swimming in treated areas. Since this herbicide is a contact chemical, control is achieved for one season at best, and treatment must be repeated annually.

Emergent species such as cattails and bulrushes may have to be sprayed for 2 or 3 consecutive years to bring them under complete control. The chemicals for cattails and other emergents are sprayed so as to wet exposed foliage thoroughly. Paraquat and Amitrole are most effective when cattails are comming into head. Dalapon should be applied using an orchard-type gun. Consult manufacturer's directions. Use of Amitrole and Dalapon is restricted to emergents in ditches and low lands which do not contain water at the time of the application. Only Paraquat is registered for emergent shoreline species.

This information is made available to the public in the Guide to Chemical Weed Control, Ontario Ministry of Agriculture and Food, publication no. 75, which is revised annually by the Ontario Herbicide Committee. Not all aquatic herbicides registered for direct water application under the federal Pest Control Products Act are necessarily included, as there may be such products as acrolein, dichlobenil or fenac whose use in Ontario is very limited because of use pattern restrictions.

HERBICIDES APPLIED DIRECTLY TO WATER

1975

PESTICIDE	NO. OF PERMITS	TOTAL AREA*	TOTAL PRODUCT*
Reglone A	157 (9 not used)	202.22 acres	358.64 gal.
Aqua Kleen	8 (2 not used)	7.4 acres	1212.5 lb.
Copper sulphate	10	6.32 acres	66.2 lb.
Cutrine	6	5.82 acres	13.15 gal.
Cutrine Plus	1	.08 acres	4.5 lb.
Karmex	1	4.87 acres	31.5 lbs.
Simmaprim	6	5.44 acres	170.86 lbs.
Gramoxone	3 (1 not used)	.06 acres	9 fl. ozs.
Terbutryn (research)	2	3.77 acres	367 lb.

*This information represents the most accurate information known from revisions made to initial calculations of total amount authorized through comments on aquatic vegetation post-treatment questionnaires.

1975 POST TREATMENT QUESTIONNAIRES

93	replies (from possible total of 194)
12	indicated they had not used permit (13%)
39.5%	of permittees had treated previously
60.5%	of permittees were new.

1975 PROBLEMS

1. Rapid spread of Eurasian water milfoil in many lakes of the Trent Canal System and the Rideau Canal System is reducing the recreational capabilities of these areas.

2. Further research needs to be done on control of dense communities of mixed submergents including pondweeds, water naiad, Canada water weed, water milfoil, tape grass and filamentous algae in localized areas where re-invasion from adjacent areas and optimum growing conditions reduce efficacy of a herbicide treatment to less than one summer season.

3. Where previous treatments for control of mixed submergents have encouraged the spread and plant community dominance of tape grass *Vallisneria americana*, herbicides currently recommended do not provide any control.

4. Control of muskgrass *Chara* spp. a common algae in spring-fed hard water trout ponds is difficult where manipulation of water flow is not possible.

5. Control of filamentous green algae in on-stream pond may last only a few days where continual reinfestation by stream input is high.

6. Herbicide treatment of nuisance vegetation (filamentous algae, chara, pondweeds and/or woody herbaceous plant) in irrigation canals and drainage ditches is not advisable where significant transport of herbicide from the site of application by moving water presents a potential hazard to crops and livestock utilizing the treated water.

(These problems have been listed in order of decreasing significance).

AQUATIC WEED RESEARCH 1975

Summary

Tests of Unregistered Compounds

1. Terbutryn (Ciba-Geigy) as a 1% granular formulation on algae and rooted submergents in a static water pond trial and two small scale lake plot trials.

2. Glyphosate (Monsanto) follow-up as a post-seeding herbicide for lake-edge emergents (wild rice) and a long term herbicide for cattails.

Tests of Registered Compounds

1. Field performance of Cutrine Plus granular in control of a dense Nitella sp. stand.

2. Field performance and herbicide persistance of Aqua Kleen in an on-stream pond treatment.

Abstracts

Aquatic vegetation control with terbutryn. Duff, P.A. and M.A. Morse. Terbutryn was applied at a rate of 0.1 mgm(a.i.)/l with a granular applicator on June 27, 1975, to an enclosed static pond in Alton infested with Chara sp. (50%) and narrow-leaf pondweed (50%). The degree of infestation was estimated at 15% bottom cover. On July 4, 1975, the narrow leaf pondweed was brown and detached from the pond bottom. At the same time, Chara was much improved from the day of treatment. On July 25, 1975, no weeds were evident and decaying plant material was noted on the pond bottom. On August 8, 1975, no changes were evident.

On July 3, 1975, terbutryn was applied at the rate of 0.1 mgm (a.i.)/l to a beach area on Doe Lake. The area was infested with yellow water lily (45%), Potamogeton sp. (45%) and tape grass (10%). The degree of infestation was estimated at 30% bottom cover. On July 14, 1975, there was very little effect on any of the weed species, expecially yellow water lily. Both healthy and somewhat unhealthy tape grass was observed and Potamogeton sp. was obviously affected. On August 7, 1975, terbutryn appeared to have had little effect overall (slight browning of Potamogeton sp., no apparent effect on tape grass and no effect on yellow water lily). Lack of control at this site is attributed to water currents moving through the treated area. (Ciba-Geigy Agrochemicals, Etobicoke, Ontario).

Wild rice control with glyphosate. MacKenzie, D.L. Evaluation was made of the wild rice Zizania aquatica test plot treated August 21, 1974 with N-phosphonomethyl glycine (glyphosate) applied at the rate of 3.3 kg acid/hectare. A strong comeback of the plant stand was feared but did not materialize. Inspection mid July, 1975 estimated no new growth in 75% of the area treated in 1974. The wild rice had just begun to seed before the glyphosate treatment in 1974 and regrowth of seeding plants this spring was scattered; lake water level was also lower this year. Improved performance may be achieved with a slight advancement of treatment date. (Ministry of the Environment, Pesticides Control Section, Toronto, Ontario).

Algae control with Cutrine Plus. Mewett, D. Cutrine Plus (granular formulation) was applied at the rate of 2.5 kg(a.i.)/ha to a dense stand of an alga, Nitella sp. on a pond plot during early June. Control was moderate to good with re-infestation of the area negligible over the summer period. Further observations and another treatment are planned in 1976.

Another study done on a small golf course pond using Cutrine Plus (granular formulation) to control Spirogyra sp. at 2.5 kg(a.i.)/hectare was unsuccessful. Mixing of the pond by the owner using a small motor boat 12 hours prior to treatment probably contributed to this failure. Heavy growth of the algae recurred in approximately 3 weeks. (Ministry of the Environment, North Bay, Ontario).

Sago pondweed control with 2,4-D granular. Putnam, G., and D.L. MacKenzie. Application of 2,4-D butoxyethanol ester granular (registered as Aqua-Kleen) at the rate of 168 kg. product per hectare (150 pounds product per surface acre) was made over a 21,760 sq. ft. pond, average depth 4 feet July 1. The onstream pond turnover time was approximately 95 days (median inflow-outflow of 4 Imp. gallons per minute). Sago pondweed Potamogeton pectinatus growing to the water surface over the entire south half of the pond showed superficial browning of tips, and plant collapse and die-off in the most shallow areas (less than 0.3 meter) after eight days; plants in all areas were affected by July 23 and 90% of the original plants had been killed by August 18 with come-back of young plants (one 0.15 m high plant per 1.2 sq. meters) in areas when water depth was less than 0.3 m. Filamentous green algae (predominantly Spirogyra sp. and some Cladophora sp.) originally just apparent increased in density by July 23 and completely covered some areas of the pond in surface mats by August 18. There was also an upsurge in the musk grass (Chara sp.) population which became quite evident by mid August. No effect was apparent on the resident trout population or ornamental shrubs bordering the pond. Mud and water samples were taken to study persistence of the 2,4-D over the summer. (Ministry of the Environment, Pesticides Control Section, Toronto, Ontario).

Appreciation is extended to H. Braun of the Provincial Pesticide Residue Testing Laboratory at Guelph for the residue analyses.

"AQUA KLEEN" TRIAL FIELD DATA, SUMMER 1975
BARNES POND, MILTON, ONTARIO.

DEPTHS: A = 9 ft., B = 7 ft., C = 4.5 ft., D = 2 ft.

	Temperature C Surface	Temperature C Bottom	Dissolved Oxygen (ppm) Surface	Dissolved Oxygen (ppm) Bottom	2,4-D butoxy ethanol ester (ppm) Water Top	2,4-D butoxy ethanol ester (ppm) Water Bottom	Sediment (dried)	% Moisture in sediment
1/7/75 (11 AM)								
Site A	24.7	23.0	7.5	-	.0276		0.182	52.0%
B	24.9	24.0	8.0	-	.0268		0.056	50.0%
C	24.9	24.0	8.5	-	.0264		0.054	42.0%
D	25.1	24.5	13.0	-	.0283		0.063	38.0%
1/7/75 (7 PM)								
Site A	27.0	24.0	7.5	-	.0234		16.1	44.0%
B	27.0	25.5	8.0	-	.0325		8.25	50.0%
C	26.3	25.0	8.5	-	.0335		32.2	50.0%
D	27.0	26.0	13.0	-	.1026		16.9	44.0%
3/7/75								
Site A	25.0	22.5	7.0	0.4	.049	.155	18.48	48.0%
B	24.9	22.0	7.5	2.2	.073	.134	0.81	38.0%
C	25.2	24.3	9.0	2.0	.226	.619	10.86	38.0%
D	25.5	24.5	14.0	8.0	.053	.147	12.44	50.0%
9/7/75								
Site A	25.1	23.2	5.0	0.2	.382	.416	1.11	38.0%
B	24.6	23.7	5.7	0.2	.520	.322	0.43	52.0%
C	26.1	24.9	8.0	5.5	.370	.291	8.33	40.0%
D	25.9	25.9	12.5	10.0	.374	.295	8.78	46.0%

Samples Collected

Top ½ Sago plants	1.88 ppm
Bottom ½ Sago plants	1.17 ppm
Water ½ mile downstream from treatment	tr (0.0002 ppm)

14/7/75

Pond inflow water sample (Temp. 13 C)	tr (0.5 ppb)
Water sample ½ mile downstream from treatment	ND

23/7/75					
Site A	25.0	23.0	5.0	0.9	Residue results
B	24.6	23.8	6.0	1.9	not available at
C	25.5	25.5	7.0	5.5	time of publi-
D	25.5	25.5	8.0	9.5	cation.

Aquatic vegetation control with terbutryn. Ridley, D.R., P.A. Duff, and M.A. Morse. Terbutryn was applied at a rate of 0.1 mgm/l with a granular applicator on June 3, 1975 to a one hectare plot, 1.2 m deep, on Puslinch Lake. The totally enclosed static lake was infested with curly-leaf pondweed (95%) and *Chara* sp. (5%). The degree of infestation was estimated at 80% bottom cover. Terbutryn residue analysis was conducted and data is presented in the table. Sampling sites 1 and 2 were in the treated area and sites 3 and 4 were outside the treated area.

Sample Date	Site	Terbutryn concentration (mgm/l)
June 3, 1975		
pre application	1	-
	2	-
	3	-
	4	-
post application (2 hr)	1	0.026
	2	0.022
	3	0.00075
	4	0.0005
June 6, 1975	1	0.017
	2	0.022
	3	0.008
	4	0.0013
June 11, 1975	1	0.0003
	2	0.0001
	3	0.0001
	4	0.0003

The concentration of terbutryn three days after application did not alter with regards to that taken two hours after application. Laboratory studies indicate no irreversible adsorption of terbutryn by the lake bottom material. This indicates that plant absorption occurred at a steady rate. Eight days after application the compound was at the limit of detection. Twelve days after application, the pondweed was dead. Areas outside of the treated plot revealed healthy pondweed. Four weeks after application the pondweed throughout the entire lake senesced and the weed population shifted to water milfoil.

Terbutryn gave excellent control of curly-leaf pondweed. Absorption by the plants is assumed to be rapid and/or equal to the release of the herbicide by the granular formultaion. (Ciba-Geigy Agrochemicals, Etobicoke, Ontario).

<u>Cattail control in ditches</u>. Taylor, W.D. 1975 assessment of 1973 and 1974 plots. Treatments of 2, 4, 2 and 4 lb active glyphosate (Mon 2139) applied in July 1973 were rated at 9, 10, 10 and 10 in July 1974. A visual assessment in June, 1975 showed a grass sod with only slight indication of cattail return.

Plots established in August 1974 of 2, 3, 2 and 3 lb active glyphosate were read at 10, 10, 10 and 10 in June, 1975. All plots were free of cattails indicating that a 2 lb rate gave complete control both years. (Soils and Crops Branch, O.M.A.F., Guelph, Ontario).

AQUATIC HERBICIDES RECOMMENDED FOR USE IN ONTARIO 1976

The 1975 recommendations previously listed (pp.) were modified in two minor ways.

(i) A separate section for weed control in dry ditches (where aquatic nuisance permits were exempt) was published under the section on weed control in non-crop land. This removed amitrol and dalapon from use for control of emergents in lake edge and wet ditch environments. This made recommendations more in line with federally registered label uses.

(ii) A separate section was included for the control of Eurasian water milfoil *Myriophyllum spicatum* in lakes:

Diquat (Reglone A), 1 gal commercial product per surface acre of water. Use higher rate (1.5 gal/A) where water depth exceeds 8 ft. Treat before July 10.

2,4-D ester (Aqua Kleen), 20 lb active per surface acre of water. Use higher rate (25 - 30 lb a.i./A) where water depth exceeds 8 ft. Treat before July 10.

One company investigated the possibility of re-establishing sales of endothall in the province and subsequently waived further action. Due to poor competition with diquat, and 2,4-D BEE under our cool water conditions, availability of such products as Aquathol and Aquathol Plus were withdrawn in 1970. Renewed interest in use of endothall (which remained federally registered) followed the dramatic establishment of Eurasian water milfoil in the Kawartha Lakes and Rideau and Trent-Severn River systems.

HERBICIDE APPLIED DIRECTLY TO WATER

1976

PESTICIDE	NO. OF PERMITS	TOTAL AREA*	TOTAL PRODUCT*
Reglone A	269 (7 not used)	696.2 acres	1339.25 gal.
Aqua Kleen	27 (3 not used)	18.85 acres	2082 lbs.
Copper sulphate	22 (1 not used)	22.86 acres	118 lbs.
Cutrine	9 (2 not used)	7.25 acres	28 gal.
Cutrine Plus	1	.38 acres	21 lbs.
Karmex	1	.5 acres	9.5 lbs.
Simmaprim	9 (1 not used)	11 acres	168 lbs.
Gramoxone	4	1.93 acres	1.75 gal.
Dalapon	1	.05 acres	1 lb.
Amitrol	4	8 acres	640 lbs.
Terbutryn (research)	7	7.47 acres	1336 lbs.
Glyphosate (research)	2	.31 acres	2 lbs. a.i.
Velpar (research)	1	.38 acres	1 lb.
Aqualin (research)	1	.38 acres	5 lbs.

*Revised to included amounts not used (when known)

1976 POST-TREATMENT QUESTIONNAIRE

182 replies (out of possible 358)
14 indicated they did not use permit (7.7%)

52.4% of permittees had treated previously
44.7% of permittees were new.

1976 PROBLEMS

1. Extensive communities of Eurasian water milfoil in many lakes and river systems in southern Ontario has greatly reduced the recreational capacities of these areas.

2. Further research needs to be done on the control of dense communities of mixed submergents including pond weeds, water naiad, Canada water weed, tape grass, water milfoil and filamentous algae in local areas when optimum growing conditions and rapid re-invasion from margin areas reduce the efficacy of a herbicide treatment to less than one summer season.

3. Where previous treatments for control of mixed submergents have encouraged the spread and shift in plant community dominance to tape grass <u>Vallisneria americana</u>, herbicides currently recommended do not provide any control.

4. Control of muskgrass <u>Chara</u> spp., an alga with the superficial appearance of a miniature pine tree, in spring-fed hard-water trout ponds is difficult where manipulation of water flow is not possible.

5. Control of filamentous green algae in on-stream ponds may last only a few days where continual re-infestation by stream input is high.

6. Herbicide treatment of nuisance aquatic vegetation in irrigation canals and drainage ditches is not advisable where significant transport of herbicide from the site of application by moving water presents a potential hazard to crops and livestock utilizing treated water.

AQUATIC WEED RESEARCH 1976

Summary

Tests of Unregistered Compounds

1. Cyanatryn (Shell) as a 10% granular formulation on filamentous algae and rooted submergents in three pond trials.

2. Terbutryn (Ciba-Geigy) as a 1% granular formulation in small open-lake plots for effect on Eurasian water milfoil. Pond work on filamentous algae and rooted submergent continued.

3. Glyphosate (Monsanto) studies on cattails continued. Rates of application and treatment times were varied.

Abstracts

Aquatic vegetation control with WL63611 (cyanatryn).
(1) Bushell, D.A., (2) Putnam, G., (2) MacKenzie, D.L.
WL63611 was applied at a nominal rate of 0.2 ppm (a.i.) by hand scattering of the pellets. Sampling of water and of sediment for residue determination, and for oxygen and water temperatures was done at three sites in each of two enclosed static ponds in the King City, Ontario area.

Pond I: Prior to treatment on June 15, 1976 had a 50-60% covering of bright green mats of filamentous green algae Cladophora spp. and a muskgrass Chara sp. population which was very dense in a 3 m x 3 m area in the deep (2m) end of the pond. The algae started to sink at the end of day 3 and was completely submerged by day 8. At the end of day 15 the musk-grass appeared to have a brown tinge, was brittle and starting to break up. At day 28 the pond was clear. Dragon fly nymphs, water spiders, water boatmen, frogs, and some small minnows were present throughout the trial without observable change.

Pond II: Prior to treatment on June 24 had a 50% infestation of narrow-leaf pondweed Potamogeton spp., about half of which had grown to the surface and started to seed. Also present was a light infestation of muskgrass throughout the pond. At the end of 8 days the pondweed previously at the surface was sinking and at the end of 14 days both plant species were brown, on the bottom and starting to break up. By the end of day 28 pond was clear and remained so for the remainder of the season.

Conclusions: All submerged weeds in the treated ponds showed evidence of control by day 8 after treatment and were normally completely controlled between days 21 and 28. Tables showing dissolved oxygen temperature, & residue follow. (1) Shell Canada Limited, Toronto) (2) Ministry of the Environment, Toronto, Ontario).

Appreciation is extended to Dr. R. Frank and the Provincial Pesticide Residue Testing Laboratory for providing the residue analyses.

	Site	Temperature C Top	Temperature C Bottom	Dissolved O_2 (ppm) Top	Dissolved O_2 (ppm) Bottom	WL63611 Residue Water (ppb)	WL63611 Residue Sediment (ppm)	Moisture %
POND 1								
Day 0	1	22.0	21.5	10.5	9.0	ND (0.1)	ND (.01)	24
	2	22.0	21.5	11.0	10.0	ND	ND	26
	3	22.0	21.5	10.0	9.0	ND	ND	32
+ 2 days	1	25.0	24.0	9.0	3.5	3.0	.02	
	2	25.0	24.0	8.0	6.0	3.9	tr	
	3	25.0	24.0	8.0	6.0	19.7	.16	
+ 8 days	1	22.0	21.5	4.0	0.4	72.0	13.44	20
	2	22.0	21.5	4.0	0.4	31.8	.20	22
	3	22.0	21.5	4.0	0.4	45.0	4.25	22
+ 14 days	1					130.0	1.29	22
	2	29.0	25.0	4.5	0	60.4	.29	16
	3					89.0	.19	16
+ 28 days	1					106.0	.433	18
	2	22.0	21.0	6.8	1.0	98.0	.139	20
	3					77.0	.059	22
+ 62 days	1	25.0	22.0	7.4	2.4		–	
POND 2								
Day 0	1	23.0	21.0	14.0	14.0	ND	ND	10
	2	23.0	21.0	15.0	16.0	ND	ND	18
	3	23.0	21.5	15.0	11.5	ND	ND	44
+ 1 day	1	26.0	21.5	13.0	14.0	5.5	.28	32
	2	25.5	22.0	12.0	10.0	3.9	.30	42
	3	26.5	20.0	12.5	7.0	1.4	.07	48
+ 3 days	1	22.0	21.0	7.5	7.0	34.3	13.1	34
	2	22.0	21.5	7.0	6.0	31.5	1.14	72
	3	22.0	21.0	8.0	7.0	37.0	331.0	58
+ 8 days	1	22.0	21.0	3.0	.4	ND	9.07	28
	2	21.5	21.0	3.0	.4	ND	.05	34
	3	21.0	21.0	3.0	.3	ND	2.0	64
+ 16 days	1	22.0	21.0	2.5	1.5	145.0	1.64	46
	2	22.0	21.0	2.5	1.5	136.0	8.80	40
	3	22.0	21.0	2.5	1.5	171.0	.16	58
+ 22 days	1	26	23	2.4	0.2	174.0	2.48	36
	2					146.0	.47	30
	3					142.0	175.2	60
+ 62 days		24	23	2.8	1.8	–	–	–

SELECTIVE control of aquatic vegetation with terbutryn. Hough K.D., J.H. Tolman and M.A. Morse. Two ponds fed sequentially from a headpond were treated on June 2, 1976 with terbutryn 1G at 0.1 ppm (a.i.) to evaluate control of a mixed infestation of curly-leaf pondweed, filamentous green algae and Canada water weed. Water flow from the headpond through Pond #1 and Pond #2 was 4.80 cubic meters per minute.

Curly leaf pondweed stayed healthy in the headpond for at least seven weeks. This weed was totally eliminated by 23 days after treatment in ponds #1 and #2 except near the inflow to Pond #1.

Total control of filamentous green algae was observed nine days after treatment, but reinfestation (with this species) ocurred about 21 days subsequent to treatment.

Although growth of Canada water weed seemed to be significantly retarded the complete kill of plants of this species was not observed.

No fish kill occurred following terbutryn application despite increased water temperature and reduced dissolved oxygen. (Ciba-Geigy Agrochemicals, Toronto, Ontario. M9C 1B2).

Control of Stonewort with cyanatryn. Mewett, D. WL63611 (cyanatryn) in pellet formulation (10% a.i.) applied at 0.2 ppm (a.i.) gave 90% control of *Nitella* spp. in a pond plot treated in late June. Reinfestation of the area was negligible over the summer period. (Ministry of the Environment, North Bay).

Control of lake vegetation with terbutryn. Hough, K.D., J.H. Tolman, and M.A. Morse. Six treatments of terbutryn 1G, ranging from 3.1 to 9.4 kg. (a.i.)/ha, were established at each of three location in Buckhorn Lake to determine the feasibility of cutting channels through extensive infestations of Eurasian water milfoil, filamentous green algae, and Canada water weed. All species showed active growth at the time of treatment. Each treatment was applied to an area 4 x 100 meters, and observed at one, two, four, and nine weeks following application. During this period all rates of terbutryn failed to give any control of the species present. Failure to reach the threshold level necessary for control is attributed to excessive dilution of the terbutryn. (Ciba-Geigy Agrochemicals, Toronto, Ontario. M9C 1B2).

Cattail control with glyphosate. McCubbin, P. A 0.0405 hectare plot was set up in Timmins, Ontario to test glyphosate for the control of broadleaf cattails *Typha latifolia* in impounded waters. The first application was applied with a knapsack sprayer at 2.240 kg (acid) per hectare August 17 followed by a second application at 4.480 kg acid per hectare on September 2. A dissipation study is currently being conducted and an evaluation of the results will continue in 1977. (Ministry of the Environment, Timmins, Ontario).

AQUATIC HERBICIDES RECOMMENDED FOR USE IN ONTARIO 1977

The 1976 Cutrine recommendations:

Filamentous algae, pond scums	Cutrine, a liquid algicide, is a chelated copper complex which remains in solution in hard water, unlike copper sulphate. 100 fl oz per acre-ft (2.9 ppm product) in moderately hard water. Water flow in ponds should not be entirely shut off during or following treatment as the subsequent oxygen depletion in a closed system may be toxic to aquatic organisms. In soft water ponds, where trout are present, chemical dosage should be halved and mimimal treatment undertaken only where necessary. This compound is not to be used in lake or open water treatments.
	and
Submerged plant-like algae: Chara and Nitella spp. in ponds	Cutrine, 200 fl oz product per acre-ft (5.8 ppm product) for control of moderately dense stands of chara. Significant pond outflow should be reduced but not entirely shut off. To avoid oxygen depletion treat one half of the pond at one time and the remainder 4 days later. In soft water ponds, where trout are present or where water hardness in unknown, Cutrine should not be used.

were replaced by Cutrine Plus liquid and granular as this product was reformulated to have longer shelf life and contained a higher concentration of active copper.

The new additions were:

Filamentous algae: pond scums	Cutrine Plus liquid algicide is a chelated copper complex which remains in solution in hard water, unlike copper sulphate. 70 fl oz product per acre-foot (2.9 ppm product) in moderately hard water. Water flow in ponds whould not be entirely shut off during or following treatment as the subsequent oxygen depletion in a closed system may be toxic to aquatic organisms. In soft water ponds, where trout are present, chemical dosage should be halved and minimal treatment undertaken only where necessary. This compound is not to be used in lake or open water treatment.
	and

Submerged plant-like algae: Chara and Nitella spp. in ponds	Cutrine Plus liquid algicide 140 fl oz product per acre-foot (5.8 ppm product) for control of moderately dense stands of Chara. Significant pond outflow should be reduced but not entirely shut off. To avoid oxygen depletion treat one half of the pond at one time and the remainder 4 days later. In soft water ponds where trout are present or where water hardness is unknown, cutrine should not be used.
	Cutrine Plus granular 60 lb product per surface acre of water for control of Chara spp., Nitella spp. and bottom growths of filamentous algae. Treat early in the season. For spot treatment, use 1 lb product per 720 sq ft; heavy growth may require re-treatment.

No other changes to the 1976 recommendations were made. Metric conversions were included in the 1976 and 1977 publication in anticipation of these changes becoming federal standards.

1 lb per acre	= 1.12 kg/ha (kilogram per hectare)
1 gal per acre	= 11.2 l/ha (litre per hectare)
1 lb per acre-foot	= 3.75 kg/ha-m (kg per hectare-metre)
1 gal per acre-foot	= 38 l/ha-m (litres per hectare-metre)

HERBICIDES APPLIED DIRECTLY TO WATER

1977

PESTICIDE	NO. OF PERMITS	TOTAL AREA*	TOTAL PRODUCT*
Reglone A	71	704 acres	1423 gal.
Aqua Kleen	75	86.74 acres	8942 lbs.
Copper sulphate	15	23.47 acres	380 lbs.
Cutrine	6	9.73 acres	19.5 gals.
Cutrine Plus	1	2.21 acres	5.5 lbs.
Algimycin	1	.1 acres	5 lbs.
Karmex	-	-	-
Simmaprim	8	16.35 acres	215.6 lbs.
Gramoxone	2	.02 acres	1.11 gal.
Dalapon	-	-	-
Amitrol	1	.1 acre	
Tebrutryn (research)	4 1	6.8 acres 4.5 acres	400 lb (1%) 25 gal (2%)
Glyphosate (research)	2	1.52 acres	3 gal.

* Adjusted to reflect known changes from returned questionnaires.

1977 POST TREATMENT QUESTIONNAIRES

197 replies (out of a possible 387)
30 indicated they had not used permit (15.2%)
53.9% of permittees had treated previously
46.1% of permittees were new.

1977 PROBLEMS

1. Eurasian water milfoil population in lakes in southern Ontario appeared to have stabilized in 1977 occupying roughly 50,000 acres. Dense stands continue to impair recreational capabilities of many waterways.

2. Where previous treatments for control of mixed submergents including pondweeds, water naiad, Canada water weed, water milfoil and tape grass have encouraged the spread and plant community dominance of tape grass *Vallisneria americana*, herbicides currently recommended do not provide any control.

3. Duration of control of aquatic vegetation (all forms) does not last beyond four to six weeks under optimum growing conditions where re-invasion from adjacent areas occurs.

4. Maximum effectiveness may not be achieved where water movement or low water temperature inhibits optimum activity within the required contact time.

5. In enriched water situations, control of filamentous green algae may not be possible for longer than a few days.

6. Control of *Cladophora* in near-shore areas in many of the Great Lakes is not possible. Filaments covering rocks and washing up on the shore cause obnoxious odour problems and make walking over the slippery ground hazardous.

7. Some species of aquatic vegetation, such as *Lobelia* and water cress, growing in very cold, fast flowing water can be a problem. No currently registered herbicide contains labelled recommendations for these species.

8. There is no activity in research on aquatic plant control in eastern Canada, other than in Ontario and little feed-back on nuisance problems (type or extent) elsewhere. Manpower, funding and planning priorities are obvious problems that have to be solved to generate further research in this area.

9. There is currently a greater demand in both the United States and Canada to confirm that there is no significant environmental hazard associated with any of the herbicides presently registered.

10. It is difficult to solicit long term interest from industry or researchers in aquatic weed problems for a number of reasons:

    (i) High cost of the product, and some understanding on the part of the public on the limitations of using herbicides in water weed management, almost guarantees that actual use will remain a rather minor market.

    (ii) Since no crop is involved, it is difficult to accurately evaluate cost benefit for what might be a recreational or aesthetic use reason.

    (iii) There is a trend now in North America to greater governmental restriction on products applied directly to the water.

AQUATIC WEED RESEARCH 1977

Summary

Tests of Unregistered Compounds

1. Dichlorophenoxyacetic acid as a dimethyl amine salt (Dow 2,4-D DMA liquid) was compared with Aqua Kleen (Amchem) for control of Eurasian water milfoil in quarter acre lake plots.

2. Fluridone (Elanco) was tested at two different rates for control of cattails.

3. Glyphosate (Monsanto) studies on cattails continued. Impact on sewage lagoon operations was studied.

Tests of Registered Compounds.

1. Simazine (Ciba-Geigy) and diuron (Du Pont) were tested as sediment injections in small lake plots for control of Eurasian water milfoil.

Abstracts

Cattail Control with glyphosate. McCubbin, P. A 0.008 hectare plot was established in a waste stabilization pond in Timmins, Ontario to test glyphosate for the control of broadleafed cattails *Typha latifolia* in that environment. The application rate was 2.240 kg acid/ha. The evaluation of the results and effect of glyphosate on a sewage environment will continue into 1978. (Ministry of Environment, Timmins, Ontario).

Cattail Control with EL-171 (fluridone). McCubbin, P. Two separate 0.004 hectare plots were established in Timmins, Ontario to test in impounded water. One site was treated July 13, 1977 at a rate of 0.911 kg acid/ha while the other site received a 1.518 kg acid/ha application. A dissipation study is currently being conducted and an evaluation of the results will continue into 1978. (Ministry of the Environment, Timmins, Ontario).

Efficacy and persistence of DMA 2,4-D and BEE 2,4-D (applied separately and in conjunction with an aquatic weed harvester) on Eurasian water milfoil (*Myriophyllum spicatum*). Carpentier, A.G. and K. Howes. Seven quarter-acre plots in Buckhorn Lake were treated with DMA 2,4-D, BEE 2,4-D, or a combination of DMA 2,4-D and an aquatic weed harvester on May 30 and June 28, 1977, to control aquatic macrophytes (primarily *Myriophyllum spicatum*). DMA 2,4-D was applied at the rate of 40 lbs of 2,4-D (a.e.)/acre and BEE 2,4-D was applied at the rate of 40 lbs (a.e.)/acre. In addition, the mechanical weed harvester was used in conjunction with the DMA 2,4-D on two of the plots in late June, 1977. Hydrasoil, water, plant and fish tissues were monitored for 2,4-D residues and analysed by the Ontario Ministry of Agriculture and Food Provincial Pesticide Residue Testing Laboratory in Guelph, Ontario. (Dr. R. Frank).

Early treatments (May) with DMA 2,4-D and BEE 2,4-D seemed to offer better, longer lasting control of *Myriophyllum spicatum* than did late treatments (June). In addition, DMA 2,4-D applied immediately after harvesting offered better control than DMA applied one week after harvesting. The overall control achieved from DMA 2,4-D versus BEE 2,4-D, as early treatments, was virtually the same; similarly there was no difference in performance between DMA 2,4-D and BEE 2,4-D applied at a later date. DMA 2,4-D offered a quicker knockdown of *Myriophyllum spicatum* but regrowth occurred resulting in similar net control to that achieved with BEE 2,4-D.

Residues in water declined rapidly after the first two weeks and seemed to stabilize at about 5 ppb for BEE 2,4-D; similar results were achieved for DMA 2,4-D. Residues in hydrasoil and plant tissues followed a similar degradation pattern. Some residue samples are yet to be received so final analyses are pending.

Samples of six fish species were collected from the study area and analysed for 2,4-D residues. Residues occurred in three fish species: large mouth bass *Micropterus salmoides*, common white sucker *Catostomus commersoni*, and brown bullhead *Ictalurus nebulosus*. Further investigation is necessary for accurate interpretation of this preliminary finding. No fish kill was found during or after the treatments. (Ministry of the Environment, Peterborough, Ontario).

Sediment injection of simazine and diuron for the control of Eurasian water milfoil (*Myriophyllum spicatum*). Neil, J.H. Four plots, 20 metres by 10 metres, in Buckhorn and Chemong Lakes, were treated with simazine and diuron applied at rates of 20 and 40 pounds (a.i.) per acre in June for the control of Eurasian water milfoil and other mixed submergent species. Application was made with a specially designed sediment injector. Assessments were made of herbicide efficacy and impact on aquatic invertebrates. No control was achieved. (Limnos Ltd., 22 Roe Avenue, Toronto).

AQUATIC HERBICIDES RECOMMENDED FOR USE IN ONTARIO 1978

The 1978 Publication 75 recommendations remained the same as 1977's with the addition of a new chelated copper algicide:

Filamentous algae, pond scums	Algimycin PLL-C liquid algicide is a chelated copper compound registered for algae control in enclosed ponds where there is no outflow into public water courses. Use 133 fl oz product per acre-foot for total pond treatments; ie: apply 266 - 400 fl oz product per acre-foot for marginal or spot treatments. For best results spot treatment should be a minimum size of 50 ft by 50 ft.
	and
Submerged plant-like algae: Chara and Nitella spp. in ponds	Algimycin PLL-C slow release granular 20 - 40 lb product per surface acre for control of Chara spp., Nitella spp., and bottom growths of filamentous algae. Treat early in the season. Use lower rate if vegetation is young and actively growing; use higher rate on dense, mature stands.

No other changes were made to the aquatics section. One addition was made for weed control in dry ditches:

Cattails	Glyphosate (Round Up) at 2½ to 3 3/4 lb in 75 to 100 gal water per acre or 1 gal (product) in 100 gal water applied to wet. Apply during mid to late flower stage (mid-July to Late-August) when cattails are actively growing.

HERBICIDES APPLIED DIRECTLY TO WATER

1978

PESTICIDE	NO. OF PERMITS	TOTAL AREA*	TOTAL PRODUCT*
Reglone A	270	580 acres	1118.72 gal.
Aqua Kleen	14 (17 not used)	32 acres	3,645 lbs.
Copper sulphate	17	30 acres	608.39 lbs.
Cutrine	13	3.28 acres	6.13 gal.
Cutrine Plus	2	3.41 acres	197 lbs.
Simmaprim	9	3.69 acres	141.4 lbs.
Gramoxone	5	2.33 acres	5.41 gal.
Amitrol	2	8.5 acres	85.4 lb. (a.i.)
Terbutryn (research)	5	.62 acres	31 lbs.

* Adjusted to reflect known changes from returned questionnaires.

From the return of post-treatment questionnaires, approximately 19.8% of permittees did not use their permits.

1978 PROBLEMS

1. The Eurasian water milfoil *Myriophyllum spicatum* population in southern Ontario appears to have decreased in productivity in 1978. There is no known reason but mixed communities of sago pondweed, native water milfoil *Myriophyllum exalbescens*, curly-leaf pondweed and tape grass now occupy areas where there was only *M. spicatum* in 1977. However, Eurasian water milfoil has *invaded* areas such as Toronto Island, where it has never been found before. It appears that this nuisance is still spreading.

2. Tape grass *Vallisneria americana* is now dense enough in many areas, *particularly when in* flower, to impede boat traffic and swimming.

3. Mixed submergents, growing densely in shallow areas, interfere with natural water flow particularly around boating marinas, and when occurring with a surface accumulation of duckweed have become aesthetically very displeasing. Where treatments have been applied, stimulation of tape grass dominance is continuing to occur.

4. Control of muskgrass *Chara sp.* and filamentous green algae i.e. *Cladophora sp.*; *Spirogyra sp.* in *lakes* is still difficult to achieve. Most algicides are registered for enclosed ponds only.

5. There are still problems with getting potential products tested and registered for aquatic use since 'aquatic weed control' still constitutes a *minor use* of herbicides. More personnel in both government and industry are needed to conduct studies in this field.

6. In both Canada and the United States there is continued demand for confirmation that there is no significant environmental hazard associated with any of the herbicides presently registered. Standard methods of herbicide evaluations in the aquatic environment have not yet been internationally endorsed.

AQUATIC WEED RESEARCH 1978

Summary

Tests of Unregistered Compounds

1. 2,4-D diethyl amine liquid (Dow) studies on Eurasian water milfoil were repeated. Comparisons were made with Reglone A (Chipman) and Aqua Kleen (Amchem).

2. Terbutryn (Ciba-Geigy) 1% granular was tested on duckweed.

3. Glyphosate (Monsanto), fluridone (Elanco) and tebuthiuron (Elanco) were compared for control of cattails.

4. Fluridone (Elanco) was screened for control of a variety of submerged and emerged aquatic plants in static pond trials.

5. Effect of water temperature on herbicidal action of terbutryn (Ciba-Geigy) was studied.

Abstracts

Efficacy of dimethylamine salt of 2,4-D (DMA 2,4-D), butoxyethanol ester of 2,4-D (BEE 2,4-D) and diquat on an aquatic macrophyte community. Carpentier, A.G., G.J. Sirons, and D.L. MacKenzie. Ten 0.1 hectare plots near Nicol's Island, Buckhorn Lake, were treated with DMA 2,4-D, BEE 2,4-D, or diquat on three separate dates during July 1978 to control aquatic macrophytes. DMA 2,4-D and BEE 2,4-D were applied at the rate 44.8 kg./hectare acid equivalent and the diquat was applied at the rate 4.48 kg. active ingredient per hectare.

Hydrosoil, water and whole plants were monitored for 2,4-D and diquat residues. All analyses were done by the Ontario Ministry of Agriculture and Food, Provincial Pesticide Residue Testing Laboratory, University of Guelph, Guelph, Ontario, (Dr. Richard Frank).

Poor control was achieved generally due to the shift in macrophyte populations from Eurasian water milfoil *Myriophyllum spicatum* L. to tapegrass *Vallisneria americana* Michx. and floating-leaf bur reed *Sparganium* sp. Both of these latter plants showed complete tolerance to all the herbicides tested. However, good control was achieved on the small patches of less tolerant species (*Elodea canadensis* Michx., *Myriophyllum spicatum* L., *Myriophyllum exalbescens* Fernald, *Ceratophyllum demersum* L.).

Abnormal conditions existed throughout most of the season, with most species beginning growth in mid-June rather than Mid-May. *Myriophyllum spicatum* attained maximum growth in mid-August, following the normal course of a late season second growth peak. It never did infiltrate the study area to any degree.

Residue analyses for almost all samples submitted have to date (Sept. '78) not been received, so final interpretations of the data are pending, (Ministry of the Environment, Peterborough).

Control of duckweed with terbutryn. Hough, K.D. and J.H. Tolman. A fully enclosed pond near Plattsville, Ontario, was treated with terbutryn at 0.1 ppm. a.i. to evaluate control of a heavy infestation of common duckweed Lemna minor. This tile and spring-fed pond was characterized by a high nutrient and organic load. Terbutryn 1G was applied on June 14, 1978 with an airblast granular applicator when the duckweed formed a healthy, compact mat over 20% of the pond surface. The water temperature at treatment time was 15 C and stabilized at 21 C for the remainder of the summer as of June 22. The duckweed appeared relatively healthy eight days after application. By June 28, 75% of the plants were dead and control was 99% 22 days following treatment. Other local ponds exhibited vigorous growth of duckweed during July and August, whereas the test pond remained free of this weed for the remainder of the season. (Ciba-Geigy Agrochemicals, Cambridge, Ontario).

Cattail Control with glyphosate. McCubbin, P. A test plot was established in August 1976 to test Roundup (glyphosate) for the control of broadleafed cattails Typha latifolia in impounded water. The herbicide was applied at a rate of 2.24 kilograms (a.e.) per hectare and then at 4.48 kg(a.e.)/ha two weeks later. By the early summer of 1977, excellent control of cattails had been achieved in the entire test plot. Although re-infestation around the perimeter of the treatment area has occurred, 90% control of broadleafed cattails has been maintained to September 1978.

On August 9, 1977 a herbicide trial was designed to evaluate glyphosate in controlling broadleafed cattails in a waste stabilization pond. The herbicide was applied at a rate of 2.24 kg(a.e.)/ha and a monitoring program was conducted to record abrupt chemical or biological changes in the lagoon. Excellent control was achieved with glyphosate in the test plot by the spring of 1978 and no detrimental effects on the lagoon operation occurred after the herbicide application. (Ministry of the Environment, Timmins, Ontario).

Cattail control with Roundup, El-171, and Spike. McCubbin, P. Three test plots were established to evaluate Roundup (glyphosate), El-171 (5% fluridone pellets) and Spike (5% tebuthiuron granules) for the control of broadleafed cattails Typha latifolia in impounded water. All plots were treated on July 21, 1978. Glyphosate was applied at a rate of 3.67 kilograms (a.e.) per hectare while El-171 was applied at 2.27 kg(a.i.)/ha and Spike at 11.34 kg(a.i.)/ha. Evaluations of results are currently being undertaken and will continue into 1979. (Ministry of the Environment, Timmins, Ontario).

Cattail Control with El-171. McCubbin, P. Two experimental plots were treated on July 13, 1977 with El-171 (fluridone) for the control of broadleafed cattails Typha latifolia in impounded water. One plot was treated at a rate of 0.91 kilogram (a.i.) per hectare and the other area at 1.36 kg(a.i.)/ha. Chlorosis was apparent on the tips of the cattail leaves in both test areas several days after the application. By the spring of 1978, no cattail control was achieved and it was decided to re-apply El-171 to both test plots.

On July 31, 1978, each plot was, therefore, treated at double the concentration it had received in 1977. (ie 1.82 kg(a.i.)/ha and 2.71 kg(a.i.)/ha). Evaluations of results will continue into 1979. (Ministry of the Environment, Timmins, Ontario).

Fluridone for Control of Aquatic Weeds. McLaughlin, Murray. Several research trials were conducted with fluridone in enclosed ponds in 1978 in Ontario. The formulation tested was a 5% pellet. Applications were made using a cyclone spreader. Rates tested were 0.84, 1.20 and 1.7 kg/ha of water surface. In the trials conducted, excellent control of cattails, bulrush, Eurasian water milfoil, Richardson's pondweed, common elodea, and sedges was obtained. It was two to four weeks before phytotoxic effects were observed and maximum control was obtained in six to eight weeks. The lower rate of 0.85 kg/ha took longer to give control equivalent to the higher rates. The aquatic weeds were controlled for the entire growing season. This slow herbicidial response is advantageous since it does not cause oxygen depletion in the water. In the trials conducted there was no effect on fish, amphibians, plankton or other forms of aquatic life present. (Elanco Products, London, Ontario).

Effect of water temperature on control of muskgrass and filamentous algae by terbutryn. Tolman, J.H. and K.D. Hough. Two small spring-fed ponds near Hillsburgh, Ontario, were treated with terbutryn at a concentration of 0.1 ppm a.i. to evaluate control of moderate to heavy infestations of muskgrass and filamentous algae. Water continued to flow through both ponds during and after the time of treatment. Pertinent information for both ponds is as follows:

	Pond #1	Pond #2
Exchange Time (hrs):	14	25
pH:	8.8	8.1
Treatment Date:	June 13, 1978	July 20, 1978
Temperature at Treatment:	10.5 C	23.0 C
Infestation at Treatment:		
Muskgrass - % bottom cover	50%	40%
% surface cover	10%	40%
Algae - % bottom cover	40%	70%
% surface cover	30%	45%

Terbutryn 1G was applied to both ponds using an air blast granular applicator.

In Pond #1 both muskgrass and filamentous algae appeared healthy and vigorous at the time of treatment. Neither was controlled by application of terbutryn, infestations actually increasing until the end of the summer when muskgrass covered 75% and filamentous algae 85% of the pond bottom. At no time during the summer did the temperature of this pond rise above 10.5 C.

Infestations of both muskgrass and filamentous algae in Pond #2 were increasing at the time of application of terbutryn 1G. By August 2, 1978, 13 days after application, both had virtually disappeared from the pond. Muskgrass did not re-appear during the remainder of the observation period; healthy filamentous algae was observed 30 days following treatment but the area infested by this algae did not increase by more than 2% prior to the end of the summer. The temperature of Pond #2 fluctuated from 12.5 C to 19.0 C during the 8 weeks following treatment.

Water temperatures below 12 C appear to adversely affect the performance of terbutryn. (Ciba-Geigy Agrochemicals, Cambridge, Ontario).

AQUATIC HERBICIDES RECOMMENDED FOR USE IN ONTARIO 1979

No changes were made to the 1978 published recommendations.

Briefly, current recommendations include:

Filamentous algae in ponds only	Copper Sulphate Cutrine Plus liquid Algimycin PLL-C Simazine Diuron
Chara and *Nitella spp.* in ponds only	Copper Sulphate Cutrine Plus liquid or granular Algimycin PLL-C granular Simazine (total volume treatment or draw down) Diuron (total volume treatment or draw down)
Mixed submergents including *Chara sp.* in ponds	Simazine Diuron
Mixed submergents in ponds and lakes excluding *Chara sp.*	Diquat 2,4-D BEE granular
Eurasian water milfoil	Diquat) low rates 2,4-D BEE granular)
Arrowhead, pickerel-weed, cattails, bul-rushes at lake edge	Paraquat
Arrowhead, pickerel-weed etc. in ditches (standing water)	Paraquat Amitrol Dalapon
(Emergent vegetation (in dry ditches)	Paraquat, Amitrol, Dalapon) and Glyphosate)
Water lilies	2,4-D BEE high rate
Duckweed	Diquat

NOTE: Not all the above can be used under all circumstances. Consult the full recommendations and label for restrictions.

HERBICIDES APPLIED DIRECTLY TO WATER

1979

PESTICIDE	NO. OF PERMITS	TOTAL AREA*	TOTAL PRODUCT*
Reglone A	264	508 acres	1426 gal.
Aqua Kleen	65	20.1 acres	1880.1 lbs.
Copper sulphate	14	4.5 acres	227 lbs.
Cutrine Plus	4	3.14 acres .38 acres	5.13 gal. 30 lbs.
Simmaprim	4	4.7 acres	54 lbs.
Gramoxone	5	5 acres	.6 gal.
Terbutryn (research)	1	2 acres	225.5 lbs.
Glyphosate (research)	1	.9 acres	
2,4-D DMA (research)	1	1.5 acres	4 gal.

*These figures were not adjusted. Information from returned post-treatment questionnaires had not been tabulated by the time of publishing.

1979 PROBLEMS

1. The Eurasian water milfoil population in many Kawartha Lakes and the Trent-Severn waterway maintained a low profile in mixed communities with other submergents. However, in some more northerly lakes and isolated Conservation Authority reservoirs (ie Mountsberg), it has become a more pronounced problem.

2. Tape grass *Vallisneria americana*, roots and all, surfaced in thick mats and fouled many lake shorelines in south central Ontario by late summer.

Other common problems have been previously identified.

AQUATIC WEED RESEARCH 1979

Summary

Tests with Unregistered Compounds

1. 2,4-D dimethyl amine (Dow) was once more compared with Aqua Kleen (Amchem) and Reglone A (Chipman) in lake plots for control of Eurasian water milfoil.

2. Terbutryn (Ciba-Geigy) 1% granular was applied to two on-stream trout ponds for control of mixed submergents and chara.

3. Glyphosate (Monsanto) follow-up was made on previous cattail trials.

4. Fluridone (Elanco) follow-up was made on previous cattail trials.

Tests with Registered Compounds

1. Aqua Kleen (Amchem) was monitored under cold water conditions (Toronto harbour, Lake Ontario).

2. Simmaprim 80 W (Ciba-Geigy) was monitored after mid-May pond drawdown treatment.

Abstracts

Efficacy of dimethylamine salt of 2,4-D (DMA 2,4-D), butoxyethanol ester of 2,4-D (BEE 2,4-D) and diquat on an aquatic macrophyte community. Carpentier, A.G., G.J. Sirons, and D.L. MacKenzie. Six 0.1 hectare plots near McKenty Island, Buckhorn Lake were treated with DMA 2,4-D, BEE 2,4-D or diquat on one of the two dates in late June or early July 1979 to control aquatic macrophytes. DMA 2,4-D and BEE 2,4-D were applied at the rate 44.815 kg(a.i.)/ha and the diquat was applied at the rate 4.48 kg(a.i.)/ha. Two control plots were established.

Hydrosoil, water and whole plants were monitored for 2,4-D and diquat residues. All analyses were done by the Ontario Ministry of Agriculture and Food, Provincial Pesticide Testing Laboratory, University of Guelph, Guelph, Ontario (Dr. R. Frank).

Control appeared generally good over all the plots shortly after treatment. *Myriophyllum spicatum* L., *M. exalbescens* Fernald., *Ceratophyllum demersum* L. and *Elodea canadensis* Michx. were controlled at the applied rates. Two or three plots showed a plant population shift shortly after treatment, with *Vallisneria americana* Michx. replacing the above-mentioned species.

A second control plot was established in late July, when the plants in the original one suddenly deteriorated.

Residue analysis for most samples submitted has not been received to date, so final interpretations of data are pending. (Ministry of the Environment, Peterborough).

2,4-D for aquatic weed control in Toronto harbour. Gaspardy, G. M. Thorndyke and D.L. MacKenzie. The Toronto Island Marina, Toronto harbour, was the site of an experimental application of butoxy-ethanol ester 2,4-D 20% granules for aquatic vegetation control. Two test plots of 0.1013 hectares each were established in areas with minimal boat traffic. Two control plots were also established, one with very little traffic, the other with much traffic and exposed to turbulance outside the marina proper. In Test Plot A, narrow-leaf pondweed Potamogeton conferviodes, Eurasian water milfoil Myriophyllum spicatum, curly-leafed pondweed Potamogeton crispus and Canada water weed Anacharis canadensis were the common weeds growing in dense stands. Bottom coverage was 100% while milfoil had reached the surface over 20% of the Plot A by July 24, 1979. In Test Plot B, narrow-leaf pondweed and curly-leafed pondweed were the problem species. Milfoil was almost absent in Plot B throughout the experiment. The "exposed" control plot, Control 1, had a dense growth of narrow-leaf pondweed (to within 30.4 cm of the surface) and Richardson's pondweed Potamogeton richardsonii over 50% of the bottom area. Control 2 was relatively weed free on July 24, having only sparse strands of milfoil.

On August 1, 1979, 11.3398 kg of 20% BEE 2,4-D was applied to each 0.1013 ha test plot using a hand-held seeder.

Water and sediment samples were taken immediately before treatment and five more times over the next 25 days. Samples were analyzed for 2,4-D by the Provincial Pesticides Residues Testing Laboratory Ontario Ministry of Agriculture and Food, Guelph, Ontario (Dr. Richard Frank).

Water temperatures showed neither stratification nor significant variation between sample days: 18 C to 20 C. Dissolved oxygen levels (determined with portable Hack kit) were stratified in the test plots, expecially Plot B (top = 21ppm; bottom = 1.5ppm pre-treatment). This extreme variation moderated through the experiment to finish at 18 ppm top and 6ppm bottom. The control plot showed no such stratification.

The herbicide treatment resulted in poor control of the weed population. In Test Plot A, the milfoil showed necrosis two weeks after treatment where the granules had settled on the plants, but the plants were not killed. Similarly, the other weeds were controlled only to the extent that the upper level of the weeds was reduced approximately 15.24 cm in both test plots. The second growth peak of milfoil occurred in the third week of August, apparently unaffected by the treatment.

Residue data has not yet been compiled and further tests are pending. (Ministry of the Environment, Toronto).

Chara control with simazine. Gaspardy, G. and D.L. MacKenzie. A privately owned pond north of Barrie, Ontario (44 40'N, 79 45'W) was again the site of a drawndown application of simazine 80% wettable powder for control of Chara vulgaris. The same treatment has been undertaken every year since 1972, except in 1973.

The water level in the 0.3038 ha stream-fed pond is controlled by a small dam. On May 18, 1979, the water was completely drained except for a small channel 60 x 30 cm running the length of the pond. Chara cover approximately 50% of the bottom to a depth of 10.16 cm but was raked out prior to treatment. On May 21, simazine was applied at 22.4 kg(a.i.)/ha to the moist mud. On May 27 the dam was closed, filling the pond to a maximum depth of 1.21 m in 10 days.

As in previous years, complete control of chara was achieved, with no regeneration by August 2. On August 26, the owner noted the first signs of chara growth but covering less than 1% of the pond bottom.

Water and sediment samples were taken from the pond and effluent stream on four occasions through the summer. Analysis for simazine residues was done by the Provincial Pesticides Residues Testing Laboratory, Ontario Ministry of Agriculture and Food, Guelph, Ontario (Dr. Richard Frank). To date, insufficient data has been returned to plot a graph of simazine degradation under these conditions.

Since 1976, blooms of filamentous algae have occurred in mid to late August at the influent end of the pond. Surface coverage rarely exceeded 10% of the whole pond. In 1979, no such bloom has yet occurred.

No fish are known to inhabit this pond. (Ministry of the Environment, Toronto).

Aquatic vegetation control in a trout pond with terbutryn. Gaspardy, G. and D.L. MacKenzie. The Mount Pleasant Provincial Fishing area (Ontario Ministry of Natural Resources) was the location of a terbutryn application on July 13, 1979, for aquatic vegetation control. The upper two of the three on-stream ponds were treated each at a rate of 0.038 ppm (a.i.) in single individual total volume treatments. Pond-water complete turn-over time was 7-8 days. The dry granular formulation (1% a.i.) was applied first to the up-stream pond then, one hour later, to the down stream pond using a motorized back-pack sprayer. A total of 102.5 kg product was used over 20,497.3 cubic meters.

Dense growths of curly-leafed pondweed Potamogeton crispus and filamentous green algae were present in two ponds prior to treatment. Canada water weed Anacharis canadensis, sago pondweed Potamogeton pectinatus, Eurasian water milfoil Myriophyllum spicatum and muskgrass Chara vulgaris were present in lesser amounts. The untreated pond, furthest downstream, had filamentous algae but was free from aquatic macrophytes throughout the summer.

In the two treated ponds P. crispus showed discolouration three days after treatment. A small percentage of this plant was floating on the surface with the remainder having fallen to the pond bottom. Filamentous algae were greatly reduced in all three ponds although only two ponds had been treated. As a result, water clarity in the three ponds increased from 10dm to 20dm in seven days. Water quality appeared otherwise unaffected.

M. spicatum, C. vulgaris and P. pectinatus were not successfully controlled. All three showed only slight discolouration and no growth reductions. A. canadensis was unaffected by the herbicide at that rate of application.

One day prior to treatment the ponds were stocked with 2,000 rainbow and speckled trout, 20 to 38 cm in length. The fish were unaffected by the herbicide.

On July 13, 1979, irrigation of a privately owned tobacco field from the treated ponds was begun. No adverse effects on the tobacco were encountered. (Ministry of the Environment, Toronto).

Glyphosate for cattail control in a private pond. Gaspardy, G. and D.L. MacKenzie. On August 17, 1979, glyphosate was applied to a test plot of cattail Typha latifolia at a rate of 4.032 kg(a.i.)/ha. The privately owned pond (total area of 0.32 ha) is located 80 km east of Toronto, Ontario. A hand-pumped knapsack sprayer was used to spray 156.27 ml of product (diluted in 29.55 litres of pond water) on 139.5 m2 of shoreline densely covered in cattails (extending into the pond 3.05 m). The remained half (139.5 m^2) of the test plot will be sprayed at the same rate on September 15, 1979, to compare the effect of the herbicide at the later application date.

By August 26, 1979, the cattails showed no sign of herbicide effect. In previous experiments (personal communication - W. Taylor, University of Guelph), no noticeable effect on the cattails was to be anticipated before at least 14 days after treatment.

Further evaluations at this site will follow. (Ministry of the Environment, Toronto).

Cattail Control with Roundup, El-171, and Spike. McCubbin, P. Three test plots were established to evaluate Roundup, (glyphosate), El-171 (5% fluridone pellets) and Spike (5% tebuthiuron granules) for the control of broadleafed cattails Typha latifolia in a drainage ditch in Northern Ontario. All plots were treated on July 21, 1978. Glyphosate was applied at a rate of 3.67 kilograms (a.i.) per hectare while El-171 was applied at 2.27 kg(a.i.)/ha and Spike at 11.34 kg(a.i.)/ha. Evaluations in September, 1979 show glyphosate had the best cattail control (98%) of the three herbicides while El-171 obtained the poorest results (5%). The Spike product achieved a fair degree of success in the control of broadleafed cattails (50%) but exhibited extensive movement of chemical downstream from the target site. (Ministry of the Environment, Timmins, Ontario).

Cattail Control with El-171. McCubbin, P. Two experimental plots were treated on July 13, 1977 with El-171 (fluridone) for the control of broadleafed cattails Typha latifolia in a drainage ditch in northern Ontario. One plot was treated at a rate of 0.91 kg(a.i.)/ha and the other area at 1.36 kg(a.i.)/ha. Chlorosis was apparent on the tips of the cattail leaves in both test areas several days after the application. By the spring of 1978, no cattail control was achieved and it was decided to re-apply El-171 to both test plots.

On July 31, 1978, each plot was treated at double the concentration it has received in 1977. (ie 1.82 kg (a.i.)/ha and 2.71 kg (a.i.)/ha. Evaluations made in late September, 1979 show that no cattail control had been achieved in either plot. (Ministry of the Environment, Timmins, Ontario).